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Influence of heavy traffic, city dwelling and socio-economic status on nasal symptoms assessed in a postal population survey

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Summary *Background:* The association between social position, living environment and nasal symptoms is inconsistent. We wanted to test how living environment, occupation and social position were associated with nasal symptoms. *Methods:* In a postal survey study of a random sample of 12,079 adults, aged 20–59 years living in the southern part of Sweden the relationship between nasal symptoms, socio-economic status and environmental factors was analysed. *Results:* The response rate was 70% ($n = 8469$) of whom 33% reported significant nasal symptoms. Nasal discharge, thick yellow discharge, a blocked nose, sneezing and itching were strongly associated with living close to heavy traffic or living in cities Most of the nasal symptoms provoked by extrinsic factors were more frequently reported among subjects who lived close to heavy traffic and in cities. Apart from thick yellow discharge and nasal symptoms provoked by damp/cold air which were more common in the socio-economic position "low" no relation to the socio-economic group was found. The prevalence of self-reported hay fever was neither affected by site of living nor by socio-economic status. Nasal symptoms evoked by "allergic" factors were linked to asthma but symptoms evoked by non-allergic factors were linked to chronic bronchitis/emphysema CBE. *Conclusions:* To conclude, we found a strong relation between geographical site and the prevalence of self-reported nasal symptoms which emphasizes the environment as a risk factor for nasal symptoms. Only by merging the socio-economic groups into "low" and "middle/high" an association to nasal symptoms was apparent. Nasal symptoms evoked by "allergic" factors were linked to asthma but symptoms evoked by "non allergic factors" were linked to CBE.

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Introduction

Upper air way symptoms are common.[1] However, data concerning the distribution in the population and environmental influences are conflicting. Hay fever has been more commonly reported for children of professional parents than for skilled, semiskilled or unskilled workers[2] and among subjects with a higher annual income compared to others.[3] These results were not confirmed in the South West London survey conducted by Sibbald and Rink in 1991[4] or in a survey conducted in Danish general practices by Weeke in 1987[5] where no social gradients were found.

Urban–rural differences are also conflicting. In Denmark a higher prevalence of hay fever has been reported in the city of Copenhagen compared to rural areas in Denmark.[6] These results were consistent with the results of Broder et al.[3] who reported a much higher prevalence of allergic rhinitis in city residents compared to rural residents. These urban–rural differences were not confirmed in a British survey.[2]

The prevalence of obstructive lung diseases and lower respiratory symptoms,[7] nasal symptoms and their relation to self-reported obstructive lung diseases[1] and the prevalence of obstructive lung diseases in relation to living environment and socio-economic group[8] in a random sample of an adult population in southern Sweden has been examined by a postal survey. The aims of the present study were to investigate the role of social position and living environment in relation to self-reported nasal symptoms by using a postal questionnaire.

An effort was made to elucidate potential links between "allergic" and "non-allergic" nasal symptoms and asthma, chronic bronchitis/emphysema (CBE) respectively.

Material and methods

Study area

The study was performed during 1992 in the southernmost part of Sweden, a part of the county of Skåne, which has the highest population density in Sweden (84 inhabitants/km^2). In 1992 the population of the county was 551,961 inhabitants.

Six different geographic areas were defined; cities ($n = 5052$), countryside ($n = 3417$), seaside ($n = 4731$), not seaside ($n = 3738$) and living close to heavy traffic ($n = 2808$) or not living close to heavy traffic ($n = 5661$). The geographical area cities, countryside, seaside, not seaside were defined according to the postal codes. Those living close to heavy traffic were identified by the question "Do you live close to a road with heavy traffic?" The two populations "living in cities" and "living close to heavy traffic" were not the same as revealed using the χ^2 test ($P<0001$). The two populations "living in cities" and "living close to heavy traffic" were not identical as revealed using the χ^2 test ($P<0001$).

Climate

The climate in the study area is of the temperate type with an average yearly temperature of $+8.4^{\circ}$C with wet and foggy winters. The average temperature of the coldest month (February) is -0.5°C and the average temperature of the warmest month (July) is $+16.8^{\circ}$C.

Air pollution in the study area

In 1992 the 12-month average of SO_2 was 7 μg/m^3, that of NO_2 was 24 μg/m^3 and that of soot was 10 μg/m^3.

Study population

For the study 12,079 individuals with comparable number of men and women in the four age groups (20–29, 30–39, 40–49 and 50–59 years) were drawn randomly from the population records. This sample comprised 4.0% of the total population in the corresponding age interval. Occupation was coded according to an socio-economic classification system elaborated by Statistics Sweden.[9] In its most aggregated form the classification of the economically active population consists of six groups: 1 "Unskilled and semiskilled workers", 2 "Skilled workers", 3 "Assistant non-manual employees", 4 "Intermediate non-manual employees", 5 "Employed and self-employed professionals, higher civil servants and executives", 6 "Self-employed (other than professionals)". In some of our analyses the economically active population was further merged into the two groups "low social position" and "middle/high social position" where low social position was defined by the groups 1 and 2 whereas middle/high social position was defined by the groups 3,4,5 and 6.

The non-economically active population is broken down into six groups; "Students" "Housewives" "Old age pensioners" "Sickness and disability pensioners" "Long term unemployed" "Military conscripts".

Those who did not state any occupation or could not be classified were coded as "not classified". Originally "Housewives" are classified according to the occupation of the husband. However, we lacked information about the occupation of the husband why housewives also were included in the group "not classified". The majority of the study-population ($n = 4527$, 53.5%) was comprised of "unskilled and semiskilled workers", "intermediate non-manual employees", "assistant non-manual employees", and "skilled workers". "Students" consti-tuted a relatively large group of the study population ($n = 665$, 7.9%). 674 individuals (8.0%) could not be classified due to missing or incomplete statement of their occupation. Detailed information with respect to the socio-economic classification of the population and smoking habits is given in Table 1.

Questionnaire

The questionnaire we used has previously been used in several Swedish studies[1,7,8,10] and included questions about upper and lower respiratory symptoms and diseases. Furthermore the questionnaire included questions about smoking habits, occupation. Specifically we asked if the subjects were lived close to heavy traffic.

The questions concerning nasal symptoms were specifically designed for this study as previously reported.[1] Lower respiratory tract symptoms were recorded as described previously[7,8] using a questionnaire originating from the British Medical Research Council questionnaire.[11] This latter part of the questionnaire has been validated by Lundbäck.[10] In all more than 50 questions were asked. In all analysis cumulative prevalence figures were used.

The questionnaire was sent to the study population during the spring of 1992. If no response was received within 2 weeks, a first reminder was sent out including a new questionnaire, and finally, after another 2 weeks, a second, final reminder was mailed.

Statistical methods

Results are presented as a percentage of positive answers to a question. Non-response to single questions are quoted as "no/do not know". Non-responders to nasal questions were less than 2%.

The computer-based analysis program SPSS (Statistical Package for the Social Sciences, 10.1 for PC, SPSS Inc., Chicago, IL, USA) was used in all calculations. The χ^2 test was used to detect differences between groups; $P < 0.05$ was considered

Table 1 The study population (20–59 years) by socio-economic group, gender and smoking habits. Figures in %.

Socio-economic group, Total group, $n = 8469$	Study population by socio-economic group. Relative prevalence (%)			Prevalence of smoking absolute prevalence (%)		
	All	M	F	All	M	F
Unskilled and semiskilled workers, $n = 1760$	20.8	37.0	63.0	38.3	36.3	39.4
Skilled workers, $n = 1163$	13.7	68.7	31.3	38.3	37.8	39.3
Assistant non-manual employees, $n = 1336$	15.8	37.7	62.3	31.5	31.3	31.6
Intermediate non-manual employees, $n = 1431$	16.9	46.1	53.9	25.9	27.0	25.0
Employed and self-employed professionals, higher civil servants and executives, $n = 810$	9.6	62.6	37.4	26.4	25.4	28.1
Self-employed (other than professionals) $n = 195$	2.3	74.9	25.1	17.9	16.4	22.4
Students, $n = 665$	7.9	43.9	56.1	27.4	24.3	29.8
Sickness and disability pensioners, $n = 154$	1.8	37.0	63.0	37.7	43.9	34.0
Long term unemployed $n = 281$	3.3	50.2	49.8	48.0	46.1	50.0
Not classified, $n = 674$	8.0	42.4	57.6	48.4	52.8	45.1
All $n = 8469$	100	47.8	52.2	33.8	33.1	34.4

M, male; F, female.

significant. Multiple logistic regression analysis was used to assess the simultaneous influence of possible determinants of self-reported asthma and CBE. Multiple logistic regression (forward likelihood ratio) analysis was performed to measure the association between possible risk factors and allergic and non-allergic nasal symptoms. In bivariate analyses no association was found between socio-economic position (low vs middle/high) and any nasal symptom and as about one fourth of the respondents were not possible to classify (due to lack of information) this variable was excluded from logistic regression analyses.

Results

Participation

After two reminders 8469 subjects (70.1%) had returned a filled-in questionnaire. There were no significant differences in response rates due to gender age or geographical site.

Nasal symptoms in general by living environment and smoking habits

In the whole study sample nasal symptoms were reported by 2768 subjects (32.7%). Allergic eye/nose catarrh was reported by 1732 subjects (20.5%).

There was a statistically significant impact of living environment and self-reported nasal symptoms. Nasal symptoms were more often reported by subjects living close to heavy traffic and by those living in cities. The impact of smoking on nasal symptoms was mixed with less allergic eye/nose catarrh but more nasal symptoms in general among smokers (Table 2).

Nasal symptoms due to extrinsic factors by living environment and smoking habits

Nasal symptoms provoked by extrinsic factors were more common among those who lived close to heavy traffic, in cities and among those who lived "not seaside" Smoking had no significant impact on nasal symptoms provoked by extrinsic factors except that smokers reported less symptoms provoked by smoke but more symptoms provoked by stress.

Nasal symptoms triggered by the allergic factors, animals and mould were more common among those who lived close to heavy traffic. Symptoms due to mould were also more common among those

Table 2 Prevalence (%) of nasal symptoms in general by living environment and smoking habits.

	Heavy traffic	Not heavy traffic	City	Countryside	Seaside	Not seaside	Smokers	Non-smokers
Self-reported allergic eye/nose catarrh	21.0	20.2	21.0	19.7	19.8	21.3	18.1	21.6*
Recurrent or permanent nasal symptoms	35.9*	31.1	34.2*	30.4	31.9	33.6	34.8*	31.6
Nasal discharge	17.9*	16.1	17.6*	15.3	16.3	17.1	16.6	16.7
Thick yellow nasal discharge	6.9*	5.1	6.4*	4.7	6.0	5.3	7.2*	4.9
Blocked nose	22.9*	19.4	21.3*	19.5	19.8	21.5	22.7*	19.5
Sneezing	19.4*	16.6	18.5*	16.2	17.1	18.1	18.2	17.2
Itching	8.3*	6.7	7.4	6.9	6.8	7.7	7.3	7.2

*$P < 0.05$.

who lived in cities compared to those who lived countryside Symptoms due to grass pollen and animals were less common among those who lived at "seaside" compared to those who lived "not seaside".

All nasal symptoms provoked by non allergic factors (damp/cold air, dry air, tobacco fumes, strong smelling scents, spicy food and stress) except red wine were more common among subjects who lived close to heavy traffic or in cities. Seaside or not seaside living had no impact on these symptoms.

Non-smokers reported more symptoms triggered by tobacco fumes but smokers reported more symptoms triggered by stress. Except these findings no effect of smoking was seen (Table 3).

Association between nasal symptoms and environmental factors, smoking and gender

Three different groups of subjects were analysed. The first group was identified by those who reported nasal symptoms provoked by one or more of the allergic factors, tree pollen, grass pollen, animals, dust or mould but where no symptoms were reported by non-allergic factors. The second group was identified by those who reported nasal symptoms provoked by one or more of the non-allergic factors, damp/cold air, dry air, tobacco fumes, strong smelling scents, spicy food, red wine or stress but where no symptoms were reported by allergic factors. The third group was made up of those who reported symptoms both when exposed to allergic and non-allergic factors.

Allergic nasal symptoms was only associated with male sex (OR 1.4; 95% CI 1.1–1.6) Non-allergic nasal symptoms were more common among subjects who lived close to heavy traffic (OR 1.3; 95% CI 1.1–1.6) or in cities (OR 1.5; 95% CI 1.2–1.8). Subjects who reported symptoms both from allergic and non-allergic factors more often lived close to heavy traffic (OR 1.3; 95% CI 1.1–1.5). Male sex was associated with lower risk (OR 0.5; 95% CI 0.4–0.6). Neither seaside living nor smoking had any impact on the prevalence of nasal symptoms in these identified groups (Table 4).

Nasal symptoms by socio-economic position

No relation between the socio-economic groups and nasal symptoms was found. However, when the economical active population was merged into the two groups "low" and "middle-high" social position it was found that thick yellow nasal discharge "and nasal symptoms triggered by damp or cold air

Table 3 Prevalence (%) of nasal symptoms due to extrinsic factors by living environment and smoking habits.

	Heavy traffic	Not heavy traffic	City	Countryside	Seaside	Not seaside	Smokers	Non-smokers
Nasal symptoms provoked by at least one extrinsic factor	20.8*	17.8	19.7*	17.4	18.0	19.7*	18.8	18.8
Tree pollen	7.4	6.6	7.1	6.6	6.6	7.2	6.7	7.0
Grass pollen	10.0	9.6	9.7	9.8	9.0	10.6*	9.2	10.0
Animals	6.4*	5.2	5.7	5.6	5.0	6.4*	5.9	5.5
Dust	7.8	7.4	7.6	7.5	7.5	7.5	7.7	7.5
Mould	5.7*	4.6	5.3*	4.4	4.6	5.4	5.5	4.7
Damp/cold air	7.5*	5.7	7.0*	5.2	5.9	6.7	6.9	6.0
Dry air	7.8*	5.1	6.5*	5.3	6.2	5.8	6.5	5.8
Tobacco fumes	9.0*	7.5	8.5*	7.2	7.8	8.3	4.4	9.9*
Strong smelling scents	9.3*	7.5	8.6*	7.2	8.1	8.1	8.0	8.1
Spicy food	3.5*	2.5	3.1*	2.3	2.6	3.0	2.8	2.7
Red wine	2.5	2.3	2.6	2.0	2.5	2.2	2.1	2.5
Stress	3.6*	2.7	3.4*	2.4	2.9	3.1	3.6*	2.7

*$P < 0.05$.

Table 4 Multiple logistic regression analysis of association between nasal symptoms and environmental factors, smoking and gender. Ods ratio (OR) and 95% Confidence interval (CI).

	Risk factor				
	Living close to heavy traffic	City dwelling	Seaside living	Smoking	Male sex
Only allergic nasal symptoms	ns	ns	ns	ns	1.4 (1.1–1.6)
Only non-allergic nasal symptoms	1.3 (1.1–1.6)	1.5 (1.2–1.8)	ns	ns	ns
Both allergic and non-allergic nasal symptoms	1.3 (1.1–1.5)	ns	ns	ns	0.5 (0.4–0.6)

Table 5 Multiple logistic regression analysis of doctor diagnosed asthma and chronic bronchitis/emphysema (CBE) due to only allergic, only non-allergic nasal symptoms, living environment and smoking habits in 20–59-year old subjects. Odds ratio (OR) and 95% confidence intervals (CI).

Risk factor	Asthma	CBE
Only allergic nasal symptoms	2.8 (2.1–3.8)	0.7 (0.4–1.3)
Only non-allergic nasal symptoms	1.0 (0.6–1.5)	2.6 (1.9–3.6)
Heavy traffic	1.3 (1.0–1.6)	1.0 (0.7–1.2)
City	0.97 (0.8–1.2)	0.9 (0.7–1.2)
Seaside	1.0 (0.8–1.3)	0.9 (0.7–1.1
Smoking	1.3 (1.0–1.6)	1.9 (1.5–2.4)

were more common among subjects in the group "low" social position compared to the group "middle-high" social position. Conversely symptoms triggered by red wine were more common among subjects in the group "middle-high" social position compared to the group "low" social position.

Nasal symptoms provoked by "allergic factors" were more common in the group "middle-high" social position.

Risk factor analysis for doctor diagnosed asthma and CBE

Nasal symptoms evoked by allergic factors were linked to doctor diagnosed asthma (OR = 2.8; 95% CI = 2.1–3.8) but symptoms evoked by non-allergic factors were linked to doctor diagnosed CBE (OR = 2.6; 95% C = 1.9–3.6). Apart from this heavy traffic was a risk factor for asthma (OR = 1.3; 95% CI = 1.0–1.6) but not for CBE. Smoking was a risk factor for both asthma and CBE (Table 5).

Discussion

This study indicates a strong association between upper respiratory symptoms and site of living suggesting environmental factors to be of importance. The association between upper respiratory symptoms and social position was weak. Nasal symptoms evoked by "allergic" factors were linked to asthma but symptoms evoked by "non-allergic factors" were linked to CBE.

Heavy traffic

Several investigators have described a relation between traffic density, asthma and allergic rhinitis. Weiland et al.[12] found a positive correlation between the prevalence of wheezing and allergic rhinitis among children, and self-reported traffic density. Kramer et al.[13] investigated the relation of road traffic and allergies in children using a questionnaire study and an allergy testing follow up with shin prick test and serology. Their findings suggest that living on busy roads is associated with a higher risk for a sensitization to pollen and could possibly be interpreted as an indication for interaction between pollen and air pollutants. Duhme et al.[14] found a positive association between allergic rhinitis and self-reported frequency of truck traffic.

Our results do not confirm these postulated associations between allergic rhinitis or allergic nasal symptoms and traffic density except nasal symptoms provoked by animals which were more frequent among subjects who lived close to heavy traffic. However, we found an association between "recurrent or permanent nasal

symptoms'' (including ''nasal discharge'', ''thick yellow nasal discharge'', ''a blocked nose'', and ''sneezing and itching'') and living close to heavy traffic (Table 2). There was also an association between non-allergic symptoms and living close to heavy traffic or living in cities (Table 4). Suppose that an urban environment and the environment close to heavy traffic is more polluted this speaks for an interaction between extrinsic irritants and nasal non-allergic symptoms. One possible explanation to our conflicting results concerning allergic rhinitis and living close to heavy traffic is that we investigated an adult population but the previous investigators focused on children who might have more sensitive nasal mucosa.

Urban–rural living

Several studies have investigated urban–rural differences in the prevalence of hay fever. Some investigators have reported a higher prevalence of hay fever in urban areas compared to rural areas[3,6,15] but others have reported no differences between urban and rural areas. Jesen and Jazon[16] found no differences regarding the prevalence of nasal complaints such as obstruction, sneezing, and discharge between city dwellers and a rural population. Charpin et al.[17] compared the population in an urban and rural setting concerning the prevalence of asthma and hay fever but found no differences. In 1995 Strachan[2] reported less hay fever in urban areas compared to non-urban areas.

In the present study those who lived close to heavy traffic or those who lived in cities in general reported more unspecific nasal symptoms (Table 2). However, we did not found any effect ''allergic eye/nose catarrh''.

The prevalence of nasal symptoms due to ''only allergic factors'' was not influenced by the environment. These findings are consistent with our findings that the prevalence of self-reported allergic eye/nose catarrh was not affected by living environment.

However, symptoms due to ''non-allergic factors'' were more common among those who lived close to heavy traffic or in the cities. Those who complained of ''both allergic and ''non-allergic factors'' more often lived close to heavy traffic (Table 4).

Socio-economic status

Previous studies have focused on the relation between hay fever and social position. The results are conflicting. Some studies have found a higher prevalence of hay fever among the professional than manual social class.[18] A similar social gradient was found in Tecumseh in the USA[3] and in the German National Health Interview and Examination Survey 1998.[19] These results have not been confirmed by other studies. Weeke et al.[5] did not find any correlation between a diagnosis of hay fever and social class in a Danish population. In the London survey conducted by Sibbald & Rink in 1991[4] no social gradient was found. Nor did Jones et al. find any effect of social class or occupation either on seasonal or perennial symptoms of allergic rhinitis.[20]

These latter results seem to be confirmed by the present study where no relation between social position and hay fever or between social position and general nasal symptoms or nasal symptoms provoked by extrinsic factors was found. However, when the economically active population was further merged into the two groups ''low social position'' and ''middle/high social position'' we found that nasal symptoms with thick yellow nasal discharge and nasal symptoms provoked by damp/cold air were more common in the group of subjects with low social position. These findings emphasize our previous findings that CBE is more common in subjects belonging to low social position and linked to the specific nasal symptoms ''yellow nasal discharge'' and ''nasal symptoms provoked by damp/cold air''[1,8]

Smoking

Our findings that smokers report less allergic eye/nose catarrh is in agreement with the findings of Strachan where regular cigarette smokers report less hay fever than non-smokers.[2] It is unlikely that tobacco smoke has a protective effect. It is more likely that subjects with allergic rhinitis have less tendency to take up smoking.[21] However smokers reported more recurrent or permanent nasal symptoms. Interestingly smoking was no risk factor for nasal symptoms triggered by extrinsic factors, except that smokers reported more nasal symptoms due to stress. However, heavy traffic and urban living were risk factors for nasal symptoms provoked by extrinsic factors.

Allergic and non-allergic nasal symptoms and their association to doctor diagnosed asthma and CBE

Previously we have reported that asthma and CBE are linked to different nasal response patterns. In those without any nasal symptoms the prevalence

figures of both asthma and CBE were low.[1] Asthma and CBE also have different environmental and socio- economic risk-factors. Heavy traffic was a risk factor for asthma but not for CBE. Low socio-economic status was a risk factor for CBE.[8] In the present study we analysed all these risk factors in a logistic regression model. Asthma and CBE were linked to allergic nasal symptoms and non-allergic symptoms respectively supporting the distinction between the different nasal response patterns between these two different bronchial diseases. The same conclusions were found when the analysis was performed using self-reported asthma and CBE instead of doctor diagnosed conditions. Data not given.

Conclusion

The main findings of this study were that we found a strong relation between geographical site and self-reported nasal symptoms which emphasizes the environment as a risk factor for nasal symptoms. Only by merging the socio-economic groups into ''low'' and ''middle/high'' an association to nasal symptoms was apparent. Nasal symptoms evoked by ''allergic'' factors were linked to asthma but symptoms evoked by non-allergic factors were linked to CBE.

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